DOCUMENT RESUME

ED 252 391 SE 045 310

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TITLE Primary School Childrens' Ideas about Spiders. Learning in Science Project (Primary). Working Paper No. 108.
INSTITUTION Waikato Univ., Hamilton (New Zealand). Science Education Research Unit.
PUB DATE Mar 82
NOTE 35p.; For related document, see SE 045 303.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Animals: Comprehension; Concept Formation; *Curriculum Development; Elementary Education; *Elementary School Science; *Entomology; Foreign Countries; *Learning Strategies; Science Curriculum; Science Education; *Science Instruction; Science Projects
IDENTIFIERS *Learning in Science Project (Primary); *New Zealand; Science Education Research; Spiders

ABSTRACT

The Learning in Science Project (Primary)--LISP(P)--investigated the questions and explanations primary children have about spiders. The data comprise 112 questions and 104 explanations (included in appendices) offered by children after being shown a picture of a spider. Additional data were collected during individual interviews with 18 students. The majority of questions raised by students were grouped into these categories: spider features; silk or web; food or prey; young or reproduction; species; poison; habitat; and origin, life, and death. Selected questions asked and some of the explanations offered in each of these categories are analyzed. They include an analysis of answers to the questions "Why do spiders have so many eyes?" and "Why does a spider's web look invisible to a fly?" Strategies used by children to gain insight to help with their ideas about spiders are also discussed. They include guessing, generalizing from a limited experience, recognizing when they have insufficient knowledge to form or offer an idea, recalling relevant past experiences, reasoning by analogy, and gaining ideas from such sources as books or television. Although these strategies must be regarded as tentative (being drawn entirely from comments children provided during interviews), they offer leads to future research into this aspect of children's thinking. (JN)

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LEARNING IN SCIENCE PROJECT (PRIMARY)

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PRIMARY SCHOOL CHILDREN'S IDEAS ABOUT SPIDERS

SE 045 310

Science Education Research Unit
University of Waikato
Hamilton, N.Z.

Working Paper No. 108

PRIMARY SCHOOL CHILDREN'S IDEAS ABOUT SPIDERS

Fred Biddulph

March 1982

A Working Paper of the Learning in Science Project (Primary)

No. 108

INTRODUCTION

It has been suggested (Symington, Osborne, Freyberg & White, 1982) that suitable topics for primary science are those which are 'close to children' in the sense that they "are part of the child's immediate world and that they are phenomena about which the child is interested, ask questions and can form real understandings." (p.6) Preliminary investigations using the procedures outlined by Symington, Osborne, Biddulph and Freyberg (1982) seemed to indicate that 'spiders' is such a topic (Biddulph & Osborne, 1982).

The present paper analyses the children's questions and explanations about 'spiders' obtained in the preliminary investigations in September/October 1982 in terms of the insights that they provide into the children's knowledge and understanding of this topic. The data comprise 112 questions (see Appendix 1) asked by children in one S.2/3 class and four S.4 classes. Also obtained were 104 explanations (see Appendix 2) by children in the same classes to three of the questions (see Table 1 below). Individual interviews with eight of the S.2/3 children, and ten of the children in one of the S.4 classes, were used to obtain further comment and viewpoints about the questions asked and explanations given by children in those classes.

TABLE 1: Typical children's questions and variety of explanations

CLASS LEVEL	QUESTIONS	NUMBER OF EXPLANATIONS
S.2./3	Why does a spider's web look invisible to a fly?	30
S.4	Why do spiders make those big cocoon things in the thistles - colonies?	14
S.4 *	[Why do they have eight eyes instead of two?	26
	[Why do spiders have eight eyes?	22
	[Why do spiders have so many eyes?	12

* These three questions are really asking the same thing and may therefore be regarded as one question.

The stimulus provided in two of the classes was a photograph of a spider, and in the other three classes it was the photograph together with a number of live spiders in clear plastic containers which the children could inspect in their groups. The type of stimulus provided seemed to make no difference either to the number or kind of questions asked by the children. The questions indicate that in most instances the children went beyond the immediate stimulus to draw upon their prior experiences and knowledge of spiders.

Many of the remarks to be made will, of necessity, be very tentative as the data were obtained during a time when Project members were exploring possible lines of research rather than pursuing a particular line in depth.

CHILDREN'S INTEREST IN SPIDERS

The questions asked by the children provide an indication of both their interest in, and their understanding of, 'spiders'. The number of questions asked by the children in each class (range 14 - 35; mean 22) suggests that the children found 'spiders' an interesting topic. A measure of the interest that children had in various aspects of the topic may also be gained from the questions they asked. Table 2 below sets out the number of questions asked by the children on different facets.

TABLE 2: Aspects of 'Spiders' about which children asked questions

	ASPECT	NUMBER OF QUESTIONS
1.	Features	20
2.	Silk or web	19
3.	Food or prey	16
4.	Young or reproduction	16
5.	Species	13
6.	Poison	12
7.	Habitat	7
8.	Origin, life, death	7
9.	Other	2

A further measure of the interest that children had in various aspects may be gained from the number of similar questions asked in each of the categories shown in Table 2 above. Table 3 below lists the number of similar questions asked by the children.

TABLE 3: Number of similar questions asked by the children in five classes.

CATEGORY		QUESTIONS RELATED TO...	NUMBER OF QUESTIONS
1.	Features	Number of eyes	4
		Number of legs	3
2.	Silk or web	Where the silk comes from	5
		Why spiders don't stick to their web	2
3.	Food or prey	Type of food eaten	3
4.	Young or reproduction	Why females die after egg laying	2
		Why young don't stay with their mother	2
5.	Species	Number of different types	3
		Number of poisonous spiders	3
6.	Habitat	Where spiders live	2
		Why some live underground	2
7.	Origin/life/death	Dangers or enemies faced by spiders	3

The children's interest in 'spiders' may be summarised as follows:

They were particularly interested in certain features of spiders such as the eyes and legs, in the spider's silk and web-making capabilities and associated web characteristics, in the type of food and circumstances related to its being eaten, and in aspects of reproduction and habits of the young. The children were also interested, although to a slightly lesser extent, in the poisoning capacity of spiders, in the variety of species and their different habitats, and in the dangers faced by spiders.

These interests are not inconsistent with the areas of study suggested for children of this age (that is, 9 - 11 years) by Science Resource Unit, Level 3, No. 50 (New Zealand Department of Education, 1980) although some of the questions asked by the children and which interested them considerably lie outside the scope of the unit, for example,

"Why do they have so many eyes?"

A final aspect of the children's interest in spiders that should not be overlooked is their attitude towards spiders. Some indication of this affective component is gained from the remarks of six children who commented on this aspect. Three girls expressed negative attitudes towards spiders,

"I hate spiders." (S.3 girl)

"They give me the creeps." (S.4 girl)

"They scare me a lot." (S.4 girl)

Two boys responded more positively,

"Everybody just thinks they're something to be scared of but they're not really." (S.3 boy)

"My mother's scared stiff of them so I like spiders." (S.4 boy)

A third boy's question may indicate that for him spiders are suitable objects for indiscriminate experimentation,

"How come their legs are so easy to pull off?"

Although they are varied, the responses suggest that for some children there is a strong affective component to the topic 'spiders'. Perhaps this is true for many children.

CHILDREN'S IDEAS ABOUT SPIDERS

The questions asked by the children provide an indication not only of their interest in spiders but also of their ideas about them. The explanations of the children to three of the questions, together with the comments of the children who were interviewed, also provide some insight into their views.

It should be noted that the children's knowledge about spiders may in some cases have been influenced by their recent experiences at school.

The children in one of the S.4 classes, for example, reported that they had studied 'spiders' a month or two previously, and a teacher reported that a group of children in one of the other S.4 classes had studied spiders earlier in the year.

1. Features and functions

The children had ideas and questions about the legs, eyes, movement and defence of spiders.

(a) Ideas about legs

Some children were not previously aware that spiders have eight legs. A S.4 girl, for example, said

"I don't know that every spider has eight legs."

Other children did realise that spiders have eight legs but they seemed to find this a bit strange, as indicated by three children who wanted to know why this was so. One, for example, asked

"Why do they have eight legs instead of four?"

There may be some confusion about the place where the legs join the rest of the spider, as the following question suggests,

"Why is it that some of them have their legs joined on to their back instead of their front?"

Finally, the question of the growth of new legs was raised by one child.

"How do spiders grow new legs?"

(b) Ideas about eyes

Depending on the species, the number of eyes possessed by a spider will vary from none to eight. Some children, however, were not aware that spiders can have more than two eyes, as evidenced by a S.4 girl who said,

"I never even realised that they had more than two eyes."

On the other hand, some children seemed to have the idea that all spiders have eight eyes, as the following child's question suggests,

"Why do they have eight eyes instead of two?"

This question, and two similar ones, indicate that, as with the number of legs, the chilren find the notion of spiders having up to eight eyes somewhat unusual and would appreciate an explanation. As Appendix 2 shows, they have a wide variety of ideas about this themselves but many of

these ideas may be more in the nature of guesses than real knowledge. This possibility is suggested by the explanation of a S.4 boy about spiders having 'eight eyes because they are near-sighted' which seems to be speculation based on the boy's interpretation of an encyclopeadia statement which he had read. He said,

> "They can't see very far away, so they have a whole lot of eyes, eight eyes, and if they only had two or something they would only be able to see um, just a short distance but um, if they got eight eyes 'cause they can see a bit further than if they only had two."

The further investigation of this question with a number of children indicates that the children had varied ideas about the location of the spiders' eyes, and about the structure of the eyes, for example,

> "it (encyclopaedia) said that they weren't all eyes. They were just parts of eyes. They had two eyes but they were just particles." (S.4 boy)

about the clarity of vision of spiders, and about their field of vision. With respect to the last some children thought that spiders can't see towards the back while others thought they can see in all directions.

(c) Ideas about movement

Four of the children's questions related to movement. The children wondered what patterns spiders' legs make when they move, how with so many legs they can run so fast, and why some spiders jump sideways. One child also pondered on another seemingly unusual bit of spider movement, or rather non-movement,

> "How does it stay on one place upside down?"

(d) Ideas about defence or attack

Two different children referred to a spider's 'sting' which suggests that some children may think of a spider as being able to sting like a bee. One of the children asked,

> "Do all spiders have a kind of sting?"

and the other described what happened to his mother on one occasion,

> "... a spider stung her on the finger and it was like a wasp sting and her finger all swelled up."

2. Silk or web

Children asked questions about, or commented on, the spider's source of silk, web construction, spider movement on the silk threads or web, and a special feature of webs.

(a) Ideas about the source of silk

A number of children apparently did not know where spiders get their silk from but, if the questions of five children are an indication, they would like to know. One of the questions suggests that a simple explanation such as 'from the spider's body' may not satisfy some children. One child asked,

> "Where does their thread come from? If it is in their bodies, how do they make it?"

The same lack of knowledge by children of the spider's source of silk became evident during an interview with two S.4 girls. One asked,

> "Where do they get it all from, the silky stuff?"

The second replied,

> "Produce it."

Unfortunately we did not find out if the first girl thought this a satisfactory explanation.

(b) Ideas about web construction

It is probable that some children do not know how spiders construct their webs, as the following question suggests,

> "How do they make their webs?"

The questions asked by other children suggest that they may have a general idea about this but be unclear about specific details such as why different types of spiders construct different types of webs, whether or not different sorts of thread are used in web construction, and how webs are attached to trees. With respect to this last point, one of the children interviewed had an idea about a possible answer. She said,

> "It's sort of sticky silk stuff, isn't it?"

(c) Ideas about the movement of spiders on silk or web

No less than seven of the children's questions referred in one way or another to the movement of spiders on silk or web. One child wondered about the ability of spiders to apparently suspend themselves in space,

"How do spiders sort of hang from nowhere?"

Others recognised that they hung from silk thread but they wondered how the spiders actually did this. Two children were puzzled as to how spiders manage to avoid being caught in their own webs. One of the children, for example, asked,

"What makes them not stick to their own webs?"

One of the S.4 girls interviewed had an idea about this. She said,

> "Parts of their web are, the circle parts I think, are sticky and the straight parts are not sticky and they do down the straight parts to get the fly, and the fly gets caught on the sticky parts and they can't get out."

Another S.4 girl wondered if the spider moves in a special pattern on the web. She commented,

> "They might have a special way to walk on their web since it goes strings, and there might be a little hole there, so they might walk a special way on it."

One child wondered how spiders stay on their webs without falling off, and another child was very puzzled as to how a spider's weight would allow it to remain on the web. The child asked,

> "How come spiders can hang on their webs because they would be just as heavy as your finger, and your finger couldn't hang there for a while?"

(d) Ideas about special features of spider webs

A number of children seemed to think that a spider's web would be invisible to a fly. This is indicated by the child who asked,

"Why does a spider's web look invisible to a fly?"

Almost a whole class of S.2/3 children accepted the question as one they thought interesting, and they wrote possible answers to it. Only one group of children in the class thought otherwise; they wrote,

"It isn't; they (flies) just think it is something to land on."

Some children thought that a spider's web is transparent. One S.3 girl described it as 'like glass, see-through'. There seemed to be

disagreement as to whether or not a web could be seen when wet. A S.2 boy said,

"It's quite easy to see when it s wet."

On the other hand another S.2 boy thought that it wasn't, although 'you can feel it'. He was supported by a S.3 girl who said,

"In the morning it's very invisible because it's got dew on it, on the outside, makes it really invisible"

by which she meant that,

"It makes it look clear, as if there is nothing there."

The girl cited an experience that she had had with one spider's web,

"I was at my grandmother's place and I was walking up the cobblestones - I hate spiders - and I was looking out for a spider web, and I walked straight through one because I couldn't see it."

A second area of apparent conflict of ideas concerns whether or not spiders camouflage their webs. One S.2 boy thought that they could, but another S.2 boy believed that they didn't.

3. Food or prey

Questions and comments by the children on the food or prey of spiders refer to what might be termed cannibalism tendencies, and to their method of catching their prey.

(a) Ideas about cannibalistic tendencies of spiders

One child wondered whether spiders do have cannibalistic tendencies,

"Do any spiders eat other spiders?"

but four other children had an idea that they did, and wondered why this was so. One child, for example, asked,

"Why do some spiders eat their own kind?"

another asked,

"Why do spiders eat their mate?"

and a third wondered,

"Why do the young spiders eat their mother?"

The last two questions indicate that some children may generalise from an instance that they have learned about.

(b) Ideas about spiders' methods of catching their prey

Whether or not some children think that all spiders catch their prey in a web is not really known, but so far as using a web is concerned, the children seemed to differ in their ideas as to how a spider can tell that a fly has been trapped. A S.4 girl thought that a spider could tell by using its eyes, whereas two S.4 boys believed that the spider was alerted by the vibrations, or the 'shiver' as one boy called them. Another idea that emerged is worth mentioning. A S.4 child appeared to be puzzled about how young spiders learn prey-catching techniques. He asked,

> "How do the babies pick up how to catch their food like their parents do?"

4. Young and reproduction

Children's questions and comments relating to reproduction and young spiders indicate that they either have ideas, or would like to have ideas, about the movement of young spiders.

At least five children had the idea that young spiders move away from their mother, usually by flight, but they wondered why this was so. One child, for example, asked,

> "After the baby ones have been hatched, why don't they stay with their mother?"

and another wanted to know,

> "When some of them are born, why do they make a parachute so they can sail away in the wind?"

One of the S.4 girls who was interviewed understood from a story about spiders that they young fly away but she may not have been too clear about how they managed it. She explained,

> "... they sort of fly away. Where do they get the wings? Or they have these little parachutes, I think, that comes up and the wind catches them, the parachutes, and they take away. Where do the parachutes come from?"

The girl's explanation suggests that she may have an image of a parachute as an umbrella-like piece of equipment that the spider perhaps plucks off a dandelion seed, rather than as a light, floating silk substance which the spider manufactures itself.

5. Species

Two areas of interest in, and ideas about, species are revealed by the children's questions and comments. These relate to the number of species, and to the features of certain species.

(a) Ideas about the number of species

Four children asked questions about the number of species that exist. For example, one child asked,

"How many different types of spider are there?"

The children's questions suggest that they did not have an idea about that aspect, although it interested them.

(b) Ideas about the features of some species

One child had the idea that some spiders can walk on water:

"How can some spiders walk on water and some spiders not?"

Other children wanted to know why spiders are often with a whole lot of others, whether or not any can fly, and the size of the biggest and smallest spiders.

6. Poison

The children expressed interest and ideas about three aspects of poison, namely the identification and number of poisonous spiders, and the use or effect of their poison.

(a) Ideas about the identification of poisonous spiders

At least one child did not know how it is possible to tell which spiders are poisonous to people. The child asked,

"How do you know which ones are poisonous to humans or not?"

Another child thought that poisonous spiders have a kind of red dot on their backs but three S.4 girls thought that some really poisonous ones did not have a red dot on their backs. Two of the girls mentioned the black widow spider as an example of one poisonous species that did not have such a marking.

(b) Ideas about the number of poisonous types of spider

The questions of three of the children indicate that they did not have an idea of how many types of poisonous spiders there are either in the world or in New Zealand. For example, one child asked,

"How many venomous ones are there?"

and another wanted to know,

"How many poisonous ones are there in New Zealand?"

One child was not too sure whether or not all spiders have poison. The child wondered,

"Do just about all spiders have poison that they bite their prey?"

Another child seemed certain that some spiders do not have poison. The child asked,

"Why do some of them have poison and not all of them?"

(c) Ideas about the use or effect of poison

The questions of three children and the remarks of another indicate that the children were extremely puzzled by the poison capabilities of spiders. Two children were apparently interested in, but did not know about, spiders that might be poisonous to humans. For example, one child asked,

"Is there any spider in the world that can kill someone?"

A S.4 boy also remarked,

"... if they can kill a fly I don't know why they can't kill us."

Another child seemed to have the same idea when s/he asked,

"How do they get the poison into the insects and kill them, and not us?"

A further child wondered why spider-eating birds don't get poisoned,

"Why is it that when a bird eats a poisonous spider it doesn't get poisoned?"

For that matter, why don't spiders poison themselves, a further child wanted to know,

"How do the poisonous ones keep the poison in their bodies without killing theirselves?"

7. Habitat

Questions and comments by the children reveal that they were interested in, and had some ideas about, the location of spider habitats, and certain specialised habitats.

(a) Ideas about the location of habitats

Two children wondered where spiders live. A S.4 boy, on the other hand, 'knew' where spiders most commonly live,

> "They're usually inside in old places that no one lives in, in the cupboards where the cockroaches are and all that."

Perhaps he had an idea that they live in other places as well but this was not discussed with him.

(b) Ideas about special habitats

One of the S.4 girls who was interviewed knew that a certain type of spider lives under water. She said,

> "Some can live in the water but they're only kind of special spiders. They wouldn't be any ordinary daddy-long-legs or anything like that."

On the other hand, another S.4 girl who was interviewed mentioned that until she heard another child say so, she was unaware that some spiders live under water,

> "I've never known that any spiders live under the water. I never knew that. I thought that they all lived underground or on top of the ground, something like that."

At least two other children also had an idea that some spiders live underground, and they wondered why. For example, one wanted to know,

> "Why does the trapdoor spider live underground?"

CHILDREN'S IDEAS ABOUT THE SUGGESTED ANSWERS TO TWO QUESTIONS

The views of ten S.4 children about answers to the question 'Why do spiders have so many eyes?' are shown in Table 4 below, and the views of eight S.2/3 children about some answers to the question "Why does a spider's web look invisible to a fly?' are shown in Table 5 below.

TABLE 4: Views of some S.4 children about their peers' answers to the question "Why do spiders have so many eyes?'

The Answers	The Children's Views				
	Gp.1	Gp.2	Gp.3	Gp.4	Gp.5
1. So that they can watch their eggs at the same time as their prey is being caught.	×	✓	✓	×	✓
2. To see if any enemies are coming.	✓	✓	✓	✓	✓
3. To scare others (i.e. insects) away when they are eating their prey.	✓	✓	×	×	✓
4. To keep a good look out if an insect comes along.	✓	✓	×	✓	×
5. If one eye gets damaged it's still got plenty more to see out of.	✓	✓	✓	×	✓
6. Because if one pair of eyes gets damaged you would have to wear glasses.	×	?	×	✓	×
7. Because they have small eyes.	✓	✓	×	✓	✓
8. Because insects are so small.	×	×	✓	✓	×
9. To help it to stand the sun's infra-red rays.	×	×	×	×	✓
10. So they can see how to mend their web.	×	×	×	✓	×
11. So they can see in lots of directions at the same time.	✓	✓	✓	✓	✓
12. So it makes it look fearsome.	✓	×	×	×	✓

KEY:

✓ Considered a good answer

× Not considered a good answer

? Not sure, or don't know.

NOTE: (Gp.1 = 3 girls; Gp.2 = 2 girls; Gp.3 = 2 boys; Gp.4 = 1 boy; Gp. 5 = 2 boys).

1. Children's ideas about answers to the question 'Why do spiders have so many eyes?'

As Table 4 shows, all children considered the answer 'To see if any enemies are coming' to be a good one. Three other answers were considered by most of the children to be good ones as well. They were,

(i) If one eye gets damaged, it's still got plenty more to see out of.

(ii) Because they have small eyes.

(iii) So they can see in lots of directions at the same time,

The rest of the answers were considered by from three to nine children to be not good ones, for various reasons.

(a) Some were rejected on the grounds that they contained an element that was perceived to be false. For example, four children thought that the answer 'Because insects are so small' was not a good one as they knew that not all insects are small compared with spiders. Similarly one child 'knew' that it it not the eyes that make spiders look fearsome; it is their legs and the spiky things on their bodies.

(b) Some answers were rejected on the grounds that they were perceived to contain a false assumption. For example, the answer 'To keep a good look out if an insect comes along' was rejected by three children because they thought that spiders do not need to keep a look out; the spiders feel the vibrations of the insect in their web. Likewise, one child rejected the idea about withstanding the sun's infra-red rays because, in his view, spiders usually keep in the shade.

(c) Other answers were rejected as they were perceived to contain false reasoning. For example, the answer 'To scare others away when they are eating their prey' was thought by two children to be not a good answer since spiders would also scare potential prey away, or other spiders may scare them away from their own prey.

(d) One answer, that about wearing glasses, was rejected by seven children, two of whom felt that the child who gave that answer was just trying to be funny.

TABLE 5: Views of some S.2/3 children about their peer's answers to the question 'Why does a spider's web look invisible to a fly?'

The Answers	The Children's Views							
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
1. The fly has so little eyes.	✓	✓	x	✓	x	x	x	x
2. The fly hasn't got very good eyesight.	?	✓	x	✓	✓	?	?	✓
3. They only see black and white.	✓	x	?	?	x	?	✓	✓
4. They are short-sighted.	✓	✓	✓	?	✓	?	?	✓
5. Because flies have compound eyes.	?	✓	✓	?	?	?	?	✓
6. Because the web is white and everything is white to a fly.	✓	x	?	✓	x	?	?	✓
7. The fly doesn't look where he is going.	?	x	x	✓	x	x	x	x
8. Because the fly is flying too fast.	✓	x	?	x	x	x	✓	✓
9. Because the web looks invisible to a fly.	✓	x	x	x	✓	?	x	x
10. The web is hard to see when dry.	✓	✓	x	x	✓	?	✓	✓
11. Because a spider sometimes put dirt and leaves in it.	✓	x	✓	✓	x	✓	x	x
12. Because it is thin and hard to see.	?	x	✓	✓	✓	✓	?	✓
13. Because the web is so fine and clear.	✓	x	✓	✓	✓	✓	?	✓
14. It isn't; they just think it is something to land on.	✓	✓	✓	x	x	✓	?	?
15. Because spiders might like flies very much.	✓	✓	?	✓	✓	?	x	x
16. The silk is too thin and skinny for the fly's eyesight.	✓	x	✓	✓	✓	✓	✓	?

KEY: ✓ Considered a good answer; x Not considered a good answer;
? Not sure, or don't know.

NOTE: (A = S.2 boy; B = S.2 boy; C = S.3 girl; D = S.2 boy; E = S.3 girl; F = S.3 boy; G = S.2 boy; H = S.3 boy).

It was also rejected by another child who just couldn't understand what it meant.

2. Children's ideas about answers to the question 'Why does a spider's web look invisible to a fly?'

As Table 5 shows, most of the children thought that answers No. 10, 12, 13 and 16 were good ones, while most rejected answer No. 7, and some children in each case rejected the others. The grounds on which answers were rejected by certain children were similar to those on which they rejected answers in the previous section, namely that they contained some element that was considered false (that is, they contained a false assumption or false reasoning) or that the children could not understand what the answer meant. These answers will not be discussed further in this paper as they refer to ideas about flies rather than ideas about spiders.

STRATEGIES USED BY CHILDREN TO GAIN IDEAS ABOUT SPIDERS

For teaching purposes it may be valuable to have information about the ways that children acquire or develop ideas. The strategies which are described below must also be regarded as tentative as they have been drawn entirely from the comments of the children who were interviewed and were not specifically investigated as such. They may, however, offer some leads to future research into this aspect of children's thinking.

A number of children, such as the girl who thought that female spiders die after they lay their egg sac, included 'I think' in their comments. It seems possible that some of these children were not very firmly committed to the ideas which they prefaced with these words. In some cases their ideas may have been little more than guesses. There were instances, however, where children used these tentative ideas as the basis for furthering reasoning. For example, one S.4 girl said,

> "A wolf spider's got eight (eyes), I think"

and then used this information to reason that,

> "... if the wolf spider gets one eye damaged it's still got seven eyes to look out of."

In contrast to the usual pattern of children unhesitatingly expressing ideas, there were several instances during the interviews when children recognised that they did not have sufficient knowledge to form or offer an idea. One of these instances was when a S.2 boy felt that he couldn't comment on whether or not the answer 'The fly hasn't got very good eyesight' was a good answer to the question 'Why does a spider's web look invisible to a fly?' He said,

> "I don't really know because I don't know much about the flies, because they might have good eyesight and they might not."

There was one instance of a S.4 girl using the idea of equivalence to decide that the answer 'Because they've (spiders) got small eyes' was a good one to the question 'Why have spiders got so many eyes?' Her reasoning was as follows,

> "Well, they could have one big eye to see out of, and they could have a couple of just medium size, but to match up for that they've got a whole lot of little ones."

A strategy that several children seemed to use to form an idea was to generalise from a limited experience. The children who asked why spiders eat their mate or mother appear to have extended an idea they had gained of some species eating their own kind, given certain conditions, to be a feature of all spiders. The boy who said that spiders are 'usually inside in old places that no one lives in' was probably using this strategy as well.

Several children seemed to be able to form ideas, or to reason, by recalling relevant past experiences. For example, a S.3 boy disagreed that flies don't look where they are going and would therefore blunder into a spider's web for that reason. His idea was,

> "I think the flies must look where they're going because when you try to whack them they always get out of the way quite quickly."

Another example was a S.2 boy whose experience told him that spiders' webs are not always fine and clear. He said,

> "Well, they're right about it being fine and clear when it hasn't got anything in it but when it's got something in it, like little midgets in it eaten, you can see them all dotted around on the thing."

A number of children seemed to reason by analogy. For example, one S.4 girl, in considering how spiders' eggs hatch, decided

> "I think that may be just like a bird; when they're ready they just eat it, eat the egg."

Sometimes the ideas were explained by human analogy. For example, another S.2 boy thought that flies may look where they are going, but they may just fly into a spider's web without noticing it

> "... because if we walk into a spider's web we don't know that we're going to walk into it."

One child, a S.3 girl, actually satisfied herself by means of a small experiment that a spider's web is visible. She described her experience to the interviewer.

Girl:	"Last night I tested it out myself."
Interviewer:	"Yes?"
Girl:	I had a look at a spider's web but I could see it quite well."
Interviewer:	"Could you?"
Girl:	"I came zooming up at it, like that, but I could see it."

Some of the children also reported gaining ideas from other sources such as books (including encyclopaedias and fiction), television, family and friends. For example, a S.4 boy who had the idea that termites can carry off young spiders said that he found this out from an encyclopaedia, a S.4 girl got the idea that insects can see infra-red from a television programme, and a S.3 boy learned that flies are short-sighted from a naturalist friend of the family.

FINAL CONSIDERATIONS

Given the relatively minimal stimulus situations arranged by the researcher for the children in the classes visited, the numerous questions and answers generated by the children, together with the comments of the children interviewed, suggest that 'spiders' is a topic which is both close and interesting to children. The children's questions indicate that in many instances they wanted to know more than that something was the case; they wanted to know why as well. It would therefore seem to be a topic with potential for primary science education.

The research on which this paper is based was not undertaken primarily for the purpose of exploring the children's ideas about spiders so that work is certainly called for in this area. In addition, the extent to which children are committed to any of the ideas which they express, or which one can infer they hold, seems to be an aspect that merits careful investigation since it would appear to be significant for teaching. Do primary children engage in considerable speculation as a means of developing ideas about their world, in this case spiders? Can they be helped to recognise the strength or otherwise of their ideas and the strategies they have used to develop them? If so, what would be the effect of such recognition for learning?

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ACKNOWLEDGEMENTS

Valuable comments by Roger Osborne and Peter Freyberg on an earlier draft of this paper were sincerely appreciated.

APPENDIX 1

QUESTIONS ASKED ABOUT SPIDERS BY CHILDREN IN ONE S.2/3 CLASS AND FOUR S.4 CLASSES

QUESTIONS ABOUT FEATURES

Re Legs

1. Why do spiders have so many legs?
2. Why do all spiders have eight legs?
3. Why do they have eight legs instead of four?
4. How do spiders grow new legs?
5. Why is it that some of them have their legs joined on to their back instead of their front?
6. How come their legs are so easy to pull off?

Re Eyes

7. Why do they have eight eyes instead of two?
8. Why do they have eight eyes?
9. Why do they have so many eyes?
10. Do all spiders have quite a few eyes?

Re Body

11. Why has it got its skeleton on the outside?
12. How many parts of the body does a spider have?
13. Why are some hairy and some not?

Re Movement

14. With so many legs, how come spiders can run so fast?
15. What patterns do their legs move when they walk?
16. Why do some spiders jump sideways?
17. How does it stay on one place upside down?

Re Colour

18. Why do they have the bright colours?
19. Why are some spiders black?

Re Defence

20. Do all spiders have a kind of sting?

QUESTIONS ABOUT SILK OR WEBS

Re Source of Silk

1. Where does all the material for their webs come from?
2. Where does their thread come from: if it is in their bodies, how do they make it?
3. Where does it get all its web-making silk from?
4. How do they get all the stuff to make the web?
5. Where do they get their silk from?

Re Web Construction

6. How do they make their webs?
7. Do they have different sorts of thread that they use for their web?
8. How do they make the web stay on the tree?
9. Why do some spiders have different webs?

Re Location of Web

10. Why do most spiders build their web high inside the house?
11. Why do spiders make those cocoon things in the thistles - colonies?

Re Spider Movement on Silk or Web

12. How come spiders can hang on their webs because they would be just as heavy as your finger and your finger couldn't hang there for a while.
13. How do spiders sort of hang from nowhere?
14. What makes them not stick to their own webs?
15. How do they not get caught in their webs when other insects do?
16. How do they stay on the web and not fall off?
17. How do they stay on the silk when they go down to the ground?
18. How come when the wind blows them off, the silk comes out of their tail and it sort of sticks?

Re Special Feature of Web

19. Why does a spider's web look invisible to a fly?

QUESTIONS ABOUT FOOD OR PREY

Re Type of Food

1. What do they eat?
2. What is the biggest prey a spider can eat?
3. What kind of food do they eat?
4. Why do spiders eat different types of food?
5. Why do they eat things that are nearly the same as them, like grasshoppers and flies which are close to them?

QUESTIONS ABOUT FOOD OR PREY Cont.

Re Cannibalism

7. Why do some spiders eat their own kind?
8. Do any spiders eat other spiders?
9. Why do spiders eat their mate?
10. Why do the young spiders eat their mother?

Re Method of Consuming Food

11. How do they eat their prey?
12. How do they get fed?

Re Method of Catching Prey

13. How many different ways do they have of catching prey?
14. Why do some spiders run after their prey instead of building a web?
15. How do they react when they have caught their prey?
16. How do the babies pick up how to catch their food like their parents do?

QUESTIONS ABOUT YOUNG OR REPRODUCTION

Re Mating

1. How do spiders mate?

Re Eggs

2. How many eggs does a spider lay?
3. Why do they lay so many eggs?
4. What do the eggs look like?
5. How do the eggs hatch?
6. When all the baby eggs are not hatched, why is it called a nursery?

Re Number of Young

7. How many baby spiders can a spider have?

Re Care of Young

8. How do spiders look after their babies?
9. How do they carry their babies around?

QUESTIONS ABOUT YOUNG OR REPRODUCTION Cont

Re Movement of Young

10. How do the young ones fly when they are born?
11. When they lay their eggs, why don't the eggs stay with their mother in a bunch instead of going away and leaving their family?
12. After the baby ones have been hatched, why don't they stay with their mother?
13. When some of them are born, why do they make a parachute so they can sail away in the wind?
14. When the eggs hatch why do the babies sort of fly away instead of spreading out from where they are?

Re Fate of Mother

15. Why does a spider that lays a batch of eggs, die?
16. Why do the females die after they lay the egg sac?

QUESTIONS ABOUT SPECIES

Re Number of Species

1. How many different types of spider are there?
2. How many known species are there?
3. How many different kinds of spiders are there?
4. What are the different kinds of spiders?

Re Features of Some Species

5. How big is the biggest one (and how small is the smallest)?
6. What is the most dangerous species?
7. Is there any spider in the world that can kill someone?
8. Why do some spiders don't die in water?
9. How can some spiders walk on water and some spiders not?
10. Are there any spiders in the world that can fly?
11. How come spiders are often with a whole lot of others?

Re Nomenclature

12. Why are daddy-long-legs called 'daddy-long-legs' and why do they have long legs?
13. How do they get their name?

QUESTIONS ABOUT POISON

Re Identification of Poisonous Spiders

1. How do you know which ones are poisonous to humans or not?
2. Why do the poisonous ones have a red kind of dot on their backs?
3. What would be the most poisonous spider in the world.

QUESTIONS ABOUT POISON Cont.

Re Number of Poisonous Kinds

4. How many venomous ones are there?
5. How many poisonous kinds of spiders are there in the world?
6. How many poisonous ones are there in New Zealand?
7. Do just about all spiders have poison that they bite their prey?
8. Why do some of them have poison and not all of them?

Re Source of Poison

9. How do they produce poison?

Re Use or Effect of Poison

10. How do they get the poison into the insects and kill them, and not us?
11. Why is it that when a bird eats a poisonous spider it doesn't get poisoned?
12. How do the poisonous ones keep the poison in their bodies without killing theirselves?

QUESTIONS ABOUT HABITAT

Re Location of Habitat

1. Where do they live?

Re Special Habitats

2. Why do some live in webs and others not?
3. Why does the trapdoor spider live underground?
4. Why do some spiders live under the ground?
5. Why do spiders live under water?

Re Habitat Protection

6. Do they camouflage where they are living?

QUESTIONS ABOUT ORIGIN, LIFE OR DEATH

Re Origin

1. How did they evolve?

APPENDIX 1 Cont

QUESTIONS ABOUT ORIGIN, LIFE OR DEATH Cont

Re Life

2. How long do they live for?
3. What do they do through their life?

Re Danger to Life

4. What dangers do spiders have?
5. Who are the spiders' dangeroust enemies?
6. What animal eats them, if there is an animal that does eat them?

Re Fate

7. How come they kind of curl up their legs when they're dead?

QUESTIONS ABOUT OTHER ASPECTS

1. Is it true if you squash a spider it will rain next day?
2. Why are some people scared of them?

S.4 CHILDREN'S ANSWERS TO QUESTION:

"WHY DO SPIDERS HAVE SO MANY EYES?"

1. So that they can watch their eggs at the same time as their prey is being caught.
2. To see if any enemies are coming.
3. To scare others (i.e. insects) away when they are eating their prey.
4. To keep a good look out if an insect comes along.
5. If one eye gets damaged it's still got plenty more to see out of.
6. Because if one pair of eyes gets damaged you would have to wear glasses.
7. Because they have small eyes.
8. Because insects are so small.
9. To help it to stand the sun's infra-red rays.
10. So they can see how to mend their webs.
11. So they can see in lots of directions at the same time.
12. So it makes it look fearsome.

S.4 CHILDREN'S ANSWERS TO QUESTION:

"WHY DO SPIDERS HAVE EIGHT EYES?"

Answers that relate to protection

1. To protect their prey from animals that will take it.
2. If they had a enemy they could see them and run away in time.
3. Because if another creature tries to kill it, it can escape.
4. So they can tell if another spider is creeping up behind him.
5. So they can see if there is anyone coming while they get their prey.
6. So they can watch both their web and birds which might think of eating them.
7. So they can guard their web.
8. To be alert for enemies.

Answers that relate to sight

9. Because they can't turn their head so they have eyes going right around their head.
10. To see in all directions.
11. Sight isn't their main sense so they need eight eyes just to be able to see, and their eyesight is still poor.
12. Because they can see in eight different places at the same time.
13. Because they need to see round them easier.
14. So they can judge the distance well.

Answers that relate to seeing prey

15. To see if a small insect is on his land.
16. To spot their prey.
17. So that when a bug gets caught in the web it can see it either ways.
18. So they can see their prey behind them and in front of them.
19. So they can see the prey in eight different places in the web.
20. So if the prey is on both sides she knows where it is.

Answers that relate to a 'back-up' function

21. If one or two eyes go blind the other eyes would take over.

Answers that relate to control

22. To control all their moves and motions (we have two eyes to see and control what we're doing with our arms and legs, so why can't spiders have eight eyes for all their legs).

S.4 CHILDREN'S ANSWERS TO QUESTION:

"WHY DO THEY HAVE EIGHT EYES INSTEAD OF TWO?"

Answers that relate to sight or better sight

1. They cannot turn their head so they have eight eyes.
2. Their eyes can't move, nor head.
3. So it can see where it is going.
4. To see in every direction.
5. To see better.
6. So they can see on their sides.
7. So they can see behind them.
8. So they are able to see where they are putting their web.
9. They don't have very good eyesight so that's why they have so many.

Answers that relate to sighting their prey

10. To see their prey at the back.
11. To see their prey easily.
12. Because they can see their prey in most directions.
13. So they can see around them quickly for their prey.
14. So they can watch all corners of the web as they sit in the centre.

Answers that relate to protection

15. So they can see if any enemies are approaching.
16. So he can see his enemy coming from behind.
17. So they can see their babies on their back.
18. To see danger quickly.

Answers that relate to an inherited feature

19. They were born that way.
20. Probably no reason; God made them that way.
21. They must think us funny only having two eyes.

Answers that relate to size

22. Because their eyes are very small so they need eight.

Answers that relate to a 'back-up' function

23. So if they get blind in one eye they have the others.
24. So they can recharge some of their eyes in the daytime to see at night time.
25. So just in case one eye tricks him he's got seven other eyes to make sure.

Answers that relate to special needs

26. So they can read.

S.4 CHILDREN'S ANSWERS TO THE QUESTION:

"WHY DO SPIDERS MAKE THOSE BIG COCOON THINGS IN THE THISTLES (COLONIES)?"

Answers that relate to protection

1. To keep themselves and their babies warm.
2. To protect themselves from the weather (wind, rain, ice, snow).
3. To protect themselves and their babies from enemies (spider-eating insects and humans).
4. The prickles stop people plus enemies from destroying their nest.
5. For camouflage.
6. To get a new set of skin.

Answers that relate to a nursery function

7. So they can mate.
8. To lay eggs.
9. So they can have babies.
10. Spiders breed in these cocoons and until the spiders are independent they stay there for protection. When they're old enough they break it open.
11. So that when they go out to get food the babies cannot run away and be eaten.

APPENDIX 2 Cont

Answers that relate to special location features

12. Because the thorns are easy for them to weave around; also they make the nest strong.

Answers that relate to a larder function

13. To put their prey in.

Answers that relate to the spiders' desire

14. Because they want to.

S.2/3 CHILDREN'S ANSWERS TO QUESTION:

"WHY DOES A SPIDER'S WEB LOOK INVISIBLE TO A FLY?"

Answers that relate to a fly's eyes

1. The fly has so little eyes.
2. The fly has lost his eyesight.
3. The fly hasn't got very good eyesight.
4. They only see black and white.
5. They are short-sighted.
6. Because they might be blind.
7. Because flies have compound eyes.
8. Because it (the web) is white and everything is white to a fly.
9 Flies have big eyes but small eyesight.

Answers that relate to a fly's movement

10. The fly doesn't look where he is going.
11. The fly is too busy looking for food.
12. The fly is looking at other things.
13. When a fly flies it would not see the web.
14. Because the fly is flying too fast.

Answers that relate to distance

15. The web isn't seen by the fly until he is a millimetre away.

Answers that relate to the web

16. Because the web looks invisible to a fly.
17. The web is hard to see when dry.
18. The sun affects it.
19. Because a spider sometimes puts dirt and leaves in it.
20. Because it is thin and hard to see.
21. It isn't; they just think it is something to land on.
22. Because the web is clear.
23. Because the web is so fine.
24. To catch flies and other flying things.
25. Because a web isn't bright and a fly can't see well.
26. Because when a bee comes the spider makes the web invisible.
27. Because the spider's web is made of silk.
28. The silk is too thin and skinny for the fly's eyesight.

Answers that relate to the spider

29. Because spiders might like flies very much.

Answers that relate to other animals

30. Because a bee's eye is not very good.

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